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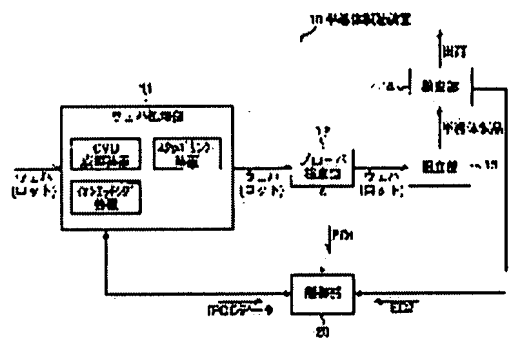
(54) PRODUCTION CONTROL METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To appropriately control production by adjusting the production according to a predicted yield by obtaining a regression expression for predicting the yield from production control data in a wafer treatment process.

SOLUTION: In a semiconductor-manufacturing device 10, a wafer treatment part 11 sends production control data in a process of a treated wafer to a control part 20. When the wafer that is treated by the wafer treatment part 11 is sent to a prober inspection part 12, the prober inspection part 12 detects the electrical characteristics of a chip in the wafer and sends them to the control part 20. An assembly part 13 assembles a chip that is inspected by the prober inspection part 12 into a semiconductor product. Then, an inspection part 14 detects electrical characteristics in a semiconductor product being assembled by the assembly part 13 to the control part 20. Also, it is judged whether the semiconductor product is conforming or not based on the electrical characteristics being detected by the inspection part 14, and the number of conforming semiconductor products is set to the control part 20. The control part 20 calculates a scheduled yield using a specific yield prediction expression and throws wafers into the wafer treatment part 11 based on the scheduled yield.



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CLAIMS

[Claim(s)]
[Claim 1] In the production-control approach which computes the schedule yield by predicting generating of the yield beforehand, feeds a predetermined wafer into semiconductor fabrication machines and equipment based on said schedule yield, and controls the volume of a semi-conductor product The electrical characteristics measured in order to inspect the chip manufactured with said semiconductor fabrication machines and equipment, Analyze a correlation with said schedule yield and the correlation of said electrical characteristics and the management data from process endoecism which is data obtained in case an electric element is formed on said wafer, and has two or more parameters is analyzed. Based on said electrical characteristics and correlation of said schedule yield, and said electrical characteristics and the correlation of said management data from process endoecism, the relation of said management data from process endoecism and said schedule yield is analyzed. The production-control approach characterized by controlling the quantity which computes said schedule yield based on said management data from process endoecism, and a wafer supplies.
[Claim 2] The analysis of the correlation of said electrical characteristics and said management data from process endoecism is the production-control approach according to claim 1 performed by extracting one parameter which affects said electrical characteristics among said management data from process endoecism.
[Claim 3] The analysis of the correlation of said electrical characteristics and said management data from process endoecism is the production-control approach according to claim 1 performed by extracting two or more parameters which affect said electrical characteristics among said management data from process endoecism.
[Claim 4] The analysis of the correlation of said electrical characteristics and said management data from process endoecism is the production-control approach according to claim 1 performed by extracting the 1st parameter which affects said electrical characteristics among said management data from process endoecism, and the 2nd parameter which affects said 1st parameter.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the production-control approach that the yield can be stopped while making the minimum fluctuation of the quantity of the semi-conductor product by amelioration of the production-control approach in semiconductor fabrication machines and equipment, especially fluctuation of the yield.
[0002]
[Description of the Prior Art] According to the demand quantity and demand term, the production control of a semi-conductor product computes the schedule yield and TAT (Turn-Around-Time: time amount taken to finish a product completely), and is performed. The yield means the rate of excellent article completion to the product quantity supplied to the production line of semiconductor fabrication machines and equipment. For example, Y=1/(1+AD) can show the prediction type which computes this yield. Y is [the chip area of a semi-conductor product and D of the yield and A] the defect density per unit area here. The yield prediction type to which the yield prediction type suited most the production line of a semi-conductor product and the type of the semi-conductor product manufactured is used.
[0003] Drawing 5 is the flow chart Fig. showing the production-control approach of the conventional semi-conductor product, and explains an example of the conventional production-control approach with reference to drawing 5 . First, the quantity manufactured based on the production line of a semi-conductor and the type of the semi-conductor manufactured is set up, and the yield prediction type which suits most is chosen from two or more yield prediction types (S1). Next, the wafer (lot) of the quantity computed by the yield prediction type is fed into a production line (S2). And a passive element, an active element, or an integrated circuit is formed on a wafer (S3). According to the manufacture type process flow of a semi-conductor product, to a wafer, a sputtering process etc. is repeated and, specifically, a chip is formed for a washing process, a diffusion process, an oxide-film formation process, a CVD membrane formation process, a photolithography process, and ion grouting. And after this wafer down stream processing is completed, electrical measurement of the processed wafer is performed and the electrical characteristics of a wafer are checked.
[0004] Then, in a prober inspection process, a wafer measures the electrical characteristics of the chip currently formed in the wafer, and distinguishes the excellent article and defective of a chip in this phase (S4). And the quantity information on an excellent article and a defective is fed back to production control, and controls the quantity of the wafer fed into a production line according to this quantity information. And the wafer which passed through the prober inspection process is assembled by the semi-conductor product (S5). And an electrical property is inspected to the chip of the manufactured semi-conductor product, and an excellent article and a defective are distinguished. And the quantity information on an excellent article and a defective is fed back to production control, and controls the quantity of the wafer fed into a production line according to this quantity information.
[0005]
[Problem(s) to be Solved by the Invention] Since the working condition of each process in wafer down

stream processing is controlled here in the predetermined range, the property of each wafer processed will become theoretical almost the same. However, in fact, since a working condition is changed with temperature, humidity, etc., dispersion produces it also in the property of a semi-conductor product. And the fixed property is not fulfilled with a defective among semi-conductor products. Therefore, the quantity of a defective becomes that to which it became what did not become fixed but was always changed, and the quantity of the manufactured excellent article was also changed.
[0006] Here, when the actual yield is less from the schedule yield computed from the yield prediction type (i.e., when fewer than the quantity which the quantity of an actual excellent article was planning), a wafer must newly be fed into a production line. However, long days are needed for dozens processes - those with hundreds processes, and a processing period after a wafer is fed into a production line (S1) until a semi-conductor product is completed (lot out). Therefore, after setting and inspecting like a prober inspection process or an erector, even if it carries out the additional injection of the wafer at a production line, there is a problem of taking time amount until fixed quantity gathers.
[0007] In order to avoid this problem, it is possible to make [many] quantity of the wafer fed into a production line from the beginning, and to throw in a lot of wafers. However, when the actual yield is almost the same as that of the schedule yield, there is a problem that a semi-conductor product will be produced superfluously. Therefore, the effect of the volume of the semi-conductor product by changing the yield is pressed down to the minimum, and the production-control approach of performing a production control appropriately is searched for.
[0008] Then, while this invention cancels the above-mentioned technical problem, suppressing the effect of the volume of the semi-conductor product by fluctuation of the yield to the minimum and making a production control suitable, it aims at offering the production-control approach that the fall of the yield can be suppressed.
[0009]
[Means for Solving the Problem] In the production-control approach which computes the schedule yield by the above-mentioned purpose predicting generating of the yield beforehand according to invention of claim 1, feeds a predetermined wafer into semiconductor fabrication machines and equipment based on said schedule yield, and controls the volume of a semi-conductor product The electrical characteristics measured in order to inspect the chip manufactured with said semiconductor fabrication machines and equipment, Analyze a correlation with said schedule yield and the correlation of said electrical characteristics and the management data from process endoecism which is data obtained in case an electric element is formed on said wafer, and has two or more parameters is analyzed. Based on said electrical characteristics and correlation of said schedule yield, and said electrical characteristics and the correlation of said management data from process endoecism, the relation of said management data from process endoecism and said schedule yield is analyzed. Said schedule yield is computed based on said management data from process endoecism, and it is attained by the production-control approach which controls the quantity which a wafer supplies.
[0010] According to the configuration of claim 1, the schedule yield is drawn by analyzing the relation between the management data from process endoecism, and the yield. Thereby, in the phase which forms the electric element on a wafer, since the schedule yield is computable, a wafer can be thrown in at an early stage and the effect of the volume on the semi-conductor product by yield fluctuation can be suppressed to the minimum.
[0011] It is attained by the production-control approach which the above-mentioned purpose extracts one parameter with which the analysis of the correlation of said electrical characteristics and said management data from process endoecism affects said electrical characteristics among said management data from process endoecism in the configuration of claim 1 according to invention of claim 2, and is performed. According to the configuration of claim 2, the schedule yield is computed based on one parameter which has affected the yield most. By performing a production control based on this schedule yield, the effect of the volume on the semi-conductor product by yield fluctuation can be suppressed to the minimum.
[0012] It is attained by the production-control approach which the above-mentioned purpose extracts

two or more parameters with which the analysis of the correlation of said electrical characteristics and said management data from process endoecism affects said electrical characteristics among said management data from process endoecism in the configuration of claim 1 according to invention of claim 3, and is performed. According to the configuration of claim 3, the schedule yield is computed based on two or more parameters which have affected the yield most. By performing a production control based on this schedule yield, the effect of the volume on the semi-conductor product by yield fluctuation can be suppressed to the minimum.

[0013] It is attained by the production-control approach which the above-mentioned purpose extracts the 1st parameter with which the analysis of the correlation of said electrical characteristics and said management data from process endoecism affects said electrical characteristics among said management data from process endoecism in the configuration of claim 1, and the 2nd parameter which affects this 1st parameter according to invention of claim 4, and is performed. According to the configuration of claim 4, the schedule yield is computed by analyzing the 1st parameter, and this 1st parameter is computed by analyzing the 2nd parameter. Therefore, in the process which processes a wafer, if the activity which affects the 2nd parameter is done, the 1st parameter will also be changed and the schedule yield will also be changed. Using this, fluctuation of the schedule yield is computed from fluctuation of the 2nd parameter, and the working condition of the affecting activity is amended to the 1st parameter in wafer down stream processing so that it may become the 1st parameter with which this schedule yield is stopped to the minimum. thereby -- the fall of the yield -- the minimum -- stopping -- ruble -- things are made.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of suitable operation of this invention is explained to a detail based on an accompanying drawing. In addition, since the gestalt of the operation described below is the suitable example of this invention, desirable various limitation is attached technically, but especially the range of this invention is not restricted to these gestalten, as long as there is no publication of the purport which limits this invention in the following explanation.

[0015] Drawing 1 is the block diagram showing an example of the semiconductor fabrication machines and equipment with which the production-control approach of this invention is applied, and explains semiconductor fabrication machines and equipment 10 with reference to drawing 1 . The semiconductor device 10 of drawing 1 consists of the wafer processing section 11, the prober Banking Inspection Department 12, the assembly section 13, the Banking Inspection Department 14, and control-section 20 grade. The wafer processing section 11 has a washing station, CVD membrane formation equipment, a sputtering system, ion etching equipment, etc., and forms a transistor, a capacitor, etc. to a wafer. Actuation of the wafer processing section 11 is controlled by the control section 20, and the wafer processing section 11 sends the process quality control data within a process of the processed wafer (it is called "IPQC data" Inline Process Quality Control and the following) to a control section 20.

[0016] Here, IPQC data are data in which information like [in substrate residual film thickness, particle, and a sputtering process] thickness, sheet resistance, and particle was included by line breadth, substrate residual film thickness, and the washing process in line breadth, the doubling gap, and the etching process at dope concentration, sheet resistance, and a photolithography process, such as the thickness, a refractive index, and Phos/Boron, at thickness and a CVD membrane formation process for example, in an oxide-film formation process.

[0017] The wafer processed in the wafer processing section 11 is sent to the prober Banking Inspection Department 12. In order to examine efficiently the electrical characteristics of the electronic circuitry formed on the wafer, the prober Banking Inspection Department 12 contacts a sensing pin to the electrode of each chip automatically, and performs the electric trial of each chip by the circuit tester of the exterior linked to a sensing pin. Here, the prober Banking Inspection Department 12 detects the electrical characteristics EC 1 of the chip in a wafer, and sends to a control section 20. These electrical characteristics EC 1 consist of two or more parameters [EC / EC (1) and / 1] 1 (2) and ... Moreover, the prober Banking Inspection Department 12 judges the quality of a chip based on electrical characteristics EC 1, and sends the quantity of an excellent article to a control section 20.

[0018] The assembly section 13 assembles the chip inspected in the prober Banking Inspection Department 12 for a semi-conductor product. The assembly section 13 has the die JINGU equipment cut from a wafer for each chip, the die bonding equipment which equips a leadframe and a package with a chip, the wirebonding equipment to which the connection electrode and external terminal on a chip are connected electrically, the packaging equipment which carries out packaging of the chip, marking equipment which attaches an alphabetic character and a notation to a package front face. The Banking Inspection Department 14 detects the electrical characteristics EC 2 in the semi-conductor product assembled by the assembly section 13, and sends to a control section 20. These electrical characteristics EC 2 consist of two or more parameters [EC / EC (1) and / 2] 2 (2) and ... Moreover, the Banking Inspection Department 14 judges the quality of a semi-conductor product based on the detected electrical characteristics EC 2, and sends the quantity of an excellent article to a control section 20.
[0019] A control section 20 performs calculation and analysis of the schedule yield while controlling actuation of semiconductor fabrication machines and equipment 10. A control section 20 computes the schedule yield using a predetermined yield prediction type, and, specifically, throws a wafer into the wafer processing section 11 based on the schedule yield. Moreover, if the schedule yield is corrected and there is need based on the quantity of the electrical characteristics EC1 and EC2 to which it is sent [electrical characteristics] from the IPQC data sent from the wafer processing section 11, the prober Banking Inspection Department 12, and the Banking Inspection Department 14, and comes, and an excellent article so that it may mention later, it will control to newly throw in a wafer.
[0020] It is the flow chart Fig. showing an example of the production-control approach of the semi-conductor of this invention, and the production-control approach of a semi-conductor is explained to drawing 2 in detail with reference to drawing 1 and drawing 2 . First, the control section 20 of drawing 1 predicts the yield beforehand (S10), and the wafer of fixed quantity is thrown into the wafer processing section 11 (S11). Then, the wafer processing section 11 performs predetermined processing to a wafer, and a chip is produced (S12). At this time, each activity section of the wafer processing section 11 measures the IPQC data to each wafer, and sends them to a control section 20.
[0021] Next, electric measurement of the chip with which the prober Banking Inspection Department 12 was produced is performed (S13), and the electrical characteristics EC 1 of a chip are detected. The prober Banking Inspection Department 12 judges the quality of a chip in the state of a wafer based on these electrical characteristics EC 1, and classifies an excellent article and a defective. Moreover, the prober Banking Inspection Department 12 also sends the quantity used as an excellent article to a control section 20. The chip judged to be an excellent article in the prober inspection process is sent to the assembly section 13. The assembly section 13 assembles a chip and produces a semi-conductor product (S14). Then, the Banking Inspection Department 14 performs electric measurement to a semi-conductor product, and detects the electrical characteristics EC 2 of a semiconductor chip (S15). The Banking Inspection Department 14 judges the quality of a semiconductor chip based on these electrical characteristics EC 2, and classifies to an excellent article and a defective. Moreover, the Banking Inspection Department 14 sends the quantity of an excellent article to a control section 20. And the semi-conductor product which finished inspection is shipped (S16).
[0022] A control section 20 asks for the schedule yield based on these electrical characteristics [EC / EC and / 2] 1 or electrical characteristics EC1 and EC2 (only hereafter referred to as "EC"). Specifically, the correlation of the electrical characteristics EC and the yield which were detected in the prober Banking Inspection Department 12 and the Banking Inspection Department 14 is analyzed first. If this is shown in a function, the yield function y1 will become like a degree type.
y1=f1 (electrical characteristics EC)
= f1 (electrical characteristics EC (1), electrical characteristics EC (2), ...) ... (1)
And this yield function y1 extracts the parameter EC of the electrical characteristics EC influenced most (m). Then, the yield function y1 turns into the yield function y1 which made electrical characteristics EC (m) the variable.
y1=f2 (electrical characteristics EC (m)) ... (2)
[0023] Next, the correlation of electrical characteristics EC (m) and IPQC data is analyzed. If this is

shown in a function, the electrical-characteristics function EC (m) will become like a degree type.
EC(m)=f3 (IPQC)
= f3 (IPQC (1), IPQC (2), ...)
... (3)
And this electrical-characteristics function EC (m) extracts one parameter IPQC (m) influenced most. For example, when a CMOS transistor is produced on a wafer, the threshold electrical potential difference Vth of the CMOS transistor is influenced by the high impurity concentration of a wafer. Therefore, one parameter of the high impurity concentration of a wafer will be extracted among IPQC data. The electrical-characteristics function EC (m) is changed into the electrical-characteristics function EC (m) which made one parameter IPQC (m) the variable here.
EC(m) =f4 (IPQC (m)) ... (4)
[0024] By the formula (2) and the formula (4), the yield function y1 serves as regression which makes a variable one parameter IPQC of IPQC data (m), as shown in a degree type.
Yield function y1=f2 (f4 (IPQC (m)))
= f5 (IPQC (m)) ... (5)
The schedule yield computed using this yield function y1 is compared with the actual yield computed based on the excellent article quantity sent from the Banking Inspection Department 14. And when the yield more nearly actual than the schedule yield is low, a control section 20 is controlled to newly throw a wafer into the wafer processing section 11.
[0025] Since the yield can be predicted from IPQC data by predicting the yield using this yield function y1, when a wafer injection is required, it can supply at an early stage, and the effect of the volume on the semi-conductor product by fluctuation of the yield can be suppressed to the minimum.
[0026] Moreover, a control section 20 can also make the working condition of the activity in the wafer processing section 11 which has affected the parameter IPQC of IPQC data (m) most change based on a formula (5). The fall of the yield can also be prevented to the minimum by changing a working condition so that it may specifically be set to IPQC (m) to which the yield y1 becomes the best in a formula (5).
[0027] The flow chart Fig. showing the gestalt of operation of the 2nd of this invention is shown in drawing 3 , and the production-control approach of a semi-conductor is explained to it with reference to drawing 3 . The point that the production-control approach of the semi-conductor of drawing 3 differs from the production-control approach of the semi-conductor of drawing 2 is a point which made the yield function y2 2 variable function which makes two parameters a variable as shown in a degree type.
y2=f10 (IPQC (m), IPQC (n)) ... (6)
Having considered as 2 variable function depends the yield function y2 on the following reasons. For example, it depends for the drain current Ids of a CMOS transistor on (gate width W / gate length L). Therefore, it turns out that it depends for a drain current on two parameters, gate width W and gate length L, among IPQC data. In this case, the yield can be more correctly predicted by computing the yield using the yield function y2 which made two parameters the variable.
[0028] Here, a formula (6) is explained concretely. First, the correlation of the electrical characteristics EC and the yield which were detected in the prober Banking Inspection Department 12 and the Banking Inspection Department 14 is analyzed. If this is shown in a function, the yield function y2 will become like a degree type.
y2=f6 (electrical characteristics EC)
= f6 (electrical characteristics EC (1), electrical characteristics EC (2), ...)
... (7)
And the parameter EC of electrical characteristics (m) with which this yield function y2 is influenced most is extracted, and the yield function y2 is changed into the yield function y2 which made electrical characteristics EC (m) the variable.
y2=f7 (electrical characteristics EC (m)) ... (8)
[0029] Next, the correlation of the parameter EC of electrical characteristics (m) and IPQC data is analyzed. If this is shown in a function, the electrical-characteristics function EC (m) will become like a

degree type.
EC(m)=f8 (IPQC)
= f8 (IPQC (1), IPQC (2), ...)
... (9)
And the electrical-characteristics function EC (m) with which this electrical-characteristics function EC (m) is influenced and which extracted two parameters IPQC (m) and IPQC (n), for example, and made the variable these two parameters IPQC (m) and IPQC (n) becomes like a degree type.
EC(m) =f9 (IPQC (m), IPQC (n)) ... (10)
[0030] By the formula (8) and the formula (10), the yield function y serves as regression which makes a variable two parameters IPQC (m) and IPQC (n).
Yield function y2=f7 (f9 (IPQC (m), IPQC (n)))
= f10 (IPQC (m), IPQC (n)) ... (6)
By predicting the yield using this yield function y2, in each process in the wafer processing section 11, the yield can be predicted from IPQC data, and a production control can be adjusted.
[0031] Moreover, a control section 20 can also make the working condition of the activity in the wafer processing section 11 which has affected most the parameters IPQC (m) and IPQC of IPQC data (n) change based on a formula (6). The fall of the yield can also be prevented to the minimum by setting up a working condition so that it may specifically be made two parameters IPQC (m) and IPQC (n) with which the yield y2 becomes good in a formula (6).
[0032] It is the flow chart Fig. showing the gestalt of implementation of the 3rd of the production-control approach of the semi-conductor of this invention, and the gestalt of the 3rd operation is explained to drawing 4 with reference to drawing 4 . The point that the gestalt of operation of the 3rd of drawing 4 differs from the gestalt of operation of the 1st of drawing 2 is that the yield function y3 is computed in consideration of the case where the 1st parameter IPQC (n) is having effect done by the 2nd parameter IPQC (m).
[0033] Specifically, the electrical characteristics EC by which two or more IPQC data are detected shall be affected. Furthermore, Parameter IPQC (m) shall have affected other parameters IPQC (n). In this case, in the process which processes a wafer, if the activity which affects the 2nd parameter is done, the 1st parameter will also be changed and the schedule yield will also be changed.
IPQC(n) =f11 (IPQC (m)) ... (11)
[0034] Therefore, fluctuation of the 1st parameter IPQC (n) and yield which the 2nd parameter IPQC (m) was changed first and changed by this is analyzed. The yield function y3 at this time becomes like a degree type.
Yield function y3=f12 (f11(IPQC (m)) ... (11))
And in order to control Parameter IPQC (m), the process working condition in the wafer processing section 11 is adjusted. Thereby, when the fall of the yield is predicted from the IPQC data of a certain process in the wafer processing section 11, a working condition is adjusted to degree process and a yield fall can be suppressed to the minimum. Moreover, the quantity which a wafer supplies can also be stopped by predicting the yield including correction of this working condition to the minimum.
[0035] Moreover, fluctuation of the schedule yield is computed from fluctuation of the 2nd parameter IPQC (m), and the working condition of the affecting activity is amended to the 1st parameter (n) in wafer down stream processing so that it may become the 1st parameter IPQC (n) with which this schedule yield is stopped. Thereby, the fall of the yield can be prevented.
[0036] In the production control of a semi-conductor product, by asking for the regression which predicts the yield from the IPQC data of wafer down stream processing, and performing a production adjustment from this prediction yield, the effect by yield fluctuation can be suppressed to the minimum, and, according to the gestalt of the above-mentioned implementation, production control can be performed appropriately. Moreover, in wafer down stream processing, the yield fall of a manufacture lot can be suppressed to the minimum by working by predicting the yield from the IPQC data after predetermined activity termination, and amending the following working condition based on this result.
[0037]

[Effect of the Invention] As explained above, according to this invention, fluctuation of the volume by yield fluctuation can be suppressed to the minimum, and a production control can be performed appropriately.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the production-control approach that the yield can be stopped while making the minimum fluctuation of the quantity of the semi-conductor product by amelioration of the production-control approach in semiconductor fabrication machines and equipment, especially fluctuation of the yield.

[Translation done.]

PRIOR ART

[Description of the Prior Art] According to the demand quantity and demand term, the production control of a semi-conductor product computes the schedule yield and TAT (Turn-Around-Time: time amount taken to finish a product completely), and is performed. The yield means the rate of excellent article completion to the product quantity supplied to the production line of semiconductor fabrication machines and equipment. For example, Y=1/(1+AD) can show the prediction type which computes this yield. Y is [the chip area of a semi-conductor product and D of the yield and A] the defect density per unit area here. The yield prediction type to which the yield prediction type suited most the production line of a semi-conductor product and the type of the semi-conductor product manufactured is used.
[0003] Drawing 5 is the flow chart Fig. showing the production-control approach of the conventional semi-conductor product, and explains an example of the conventional production-control approach with reference to drawing 5 . First, the quantity manufactured based on the production line of a semi-conductor and the type of the semi-conductor manufactured is set up, and the yield prediction type which suits most is chosen from two or more yield prediction types (S1). Next, the wafer (lot) of the quantity computed by the yield prediction type is fed into a production line (S2). And a passive element, an active element, or an integrated circuit is formed on a wafer (S3). According to the manufacture type process flow of a semi-conductor product, to a wafer, a sputtering process etc. is repeated and, specifically, a chip is formed for a washing process, a diffusion process, an oxide-film formation process, a CVD membrane formation process, a photolithography process, and ion grouting. And after this wafer down stream processing is completed, electrical measurement of the processed wafer is performed and the electrical characteristics of a wafer are checked.
[0004] Then, in a prober inspection process, a wafer measures the electrical characteristics of the chip currently formed in the wafer, and distinguishes the excellent article and defective of a chip in this phase (S4). And the quantity information on an excellent article and a defective is fed back to production control, and controls the quantity of the wafer fed into a production line according to this quantity information. And the wafer which passed through the prober inspection process is assembled by the semi-conductor product (S5). And an electrical property is inspected to the chip of the manufactured semi-conductor product, and an excellent article and a defective are distinguished. And the quantity information on an excellent article and a defective is fed back to production control, and controls the quantity of the wafer fed into a production line according to this quantity information.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, fluctuation of the volume by yield fluctuation can be suppressed to the minimum, and a production control can be performed appropriately.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since the working condition of each process in wafer down stream processing is controlled here in the predetermined range, the property of each wafer processed will become theoretical almost the same. However, in fact, since a working condition is changed with temperature, humidity, etc., dispersion produces it also in the property of a semi-conductor product. And the fixed property is not fulfilled with a defective among semi-conductor products. Therefore, the quantity of a defective becomes that to which it became what did not become fixed but was always changed, and the quantity of the manufactured excellent article was also changed.
[0006] Here, when the actual yield is less from the schedule yield computed from the yield prediction type (i.e., when fewer than the quantity which the quantity of an actual excellent article was planning), a wafer must newly be fed into a production line. However, long days are needed for dozens processes - those with hundreds processes, and a processing period after a wafer is fed into a production line (S1) until a semi-conductor product is completed (lot out). Therefore, after setting and inspecting like a prober inspection process or an erector, even if it carries out the additional injection of the wafer at a production line, there is a problem of taking time amount until fixed quantity gathers.
[0007] In order to avoid this problem, it is possible to make [many] quantity of the wafer fed into a production line from the beginning, and to throw in a lot of wafers. However, when the actual yield is almost the same as that of the schedule yield, there is a problem that a semi-conductor product will be produced superfluously. Therefore, the effect of the volume of the semi-conductor product by changing the yield is pressed down to the minimum, and the production-control approach of performing a production control appropriately is searched for.
[0008] Then, while this invention cancels the above-mentioned technical problem, suppressing the effect of the volume of the semi-conductor product by fluctuation of the yield to the minimum and making a production control suitable, it aims at offering the production-control approach that the fall of the yield can be suppressed.

[Translation done.]

* NOTICES *

MEANS

[Means for Solving the Problem] In the production-control approach which computes the schedule yield by the above-mentioned purpose predicting generating of the yield beforehand according to invention of claim 1, feeds a predetermined wafer into semiconductor fabrication machines and equipment based on said schedule yield, and controls the volume of a semi-conductor product The electrical characteristics measured in order to inspect the chip manufactured with said semiconductor fabrication machines and equipment, Analyze a correlation with said schedule yield and the correlation of said electrical characteristics and the management data from process endoecism which is data obtained in case an electric element is formed on said wafer, and has two or more parameters is analyzed. Based on said electrical characteristics and correlation of said schedule yield, and said electrical characteristics and the correlation of said management data from process endoecism, the relation of said management data from process endoecism and said schedule yield is analyzed. Said schedule yield is computed based on said management data from process endoecism, and it is attained by the production-control approach which controls the quantity which a wafer supplies.
[0010] According to the configuration of claim 1, the schedule yield is drawn by analyzing the relation between the management data from process endoecism, and the yield. Thereby, in the phase which forms the electric element on a wafer, since the schedule yield is computable, a wafer can be thrown in at an early stage and the effect of the volume on the semi-conductor product by yield fluctuation can be suppressed to the minimum.
[0011] It is attained by the production-control approach which the above-mentioned purpose extracts one parameter with which the analysis of the correlation of said electrical characteristics and said management data from process endoecism affects said electrical characteristics among said management data from process endoecism in the configuration of claim 1 according to invention of claim 2, and is performed. According to the configuration of claim 2, the schedule yield is computed based on one parameter which has affected the yield most. By performing a production control based on this schedule yield, the effect of the volume on the semi-conductor product by yield fluctuation can be suppressed to the minimum.
[0012] It is attained by the production-control approach which the above-mentioned purpose extracts two or more parameters with which the analysis of the correlation of said electrical characteristics and said management data from process endoecism affects said electrical characteristics among said management data from process endoecism in the configuration of claim 1 according to invention of claim 3, and is performed. According to the configuration of claim 3, the schedule yield is computed based on two or more parameters which have affected the yield most. By performing a production control based on this schedule yield, the effect of the volume on the semi-conductor product by yield fluctuation can be suppressed to the minimum.
[0013] It is attained by the production-control approach which the above-mentioned purpose extracts the 1st parameter with which the analysis of the correlation of said electrical characteristics and said management data from process endoecism affects said electrical characteristics among said management data from process endoecism in the configuration of claim 1, and the 2nd parameter which affects this

1st parameter according to invention of claim 4, and is performed. According to the configuration of claim 4, the schedule yield is computed by analyzing the 1st parameter, and this 1st parameter is computed by analyzing the 2nd parameter. Therefore, in the process which processes a wafer, if the activity which affects the 2nd parameter is done, the 1st parameter will also be changed and the schedule yield will also be changed. Using this, fluctuation of the schedule yield is computed from fluctuation of the 2nd parameter, and the working condition of the affecting activity is amended to the 1st parameter in wafer down stream processing so that it may become the 1st parameter with which this schedule yield is stopped to the minimum. thereby -- the fall of the yield -- the minimum -- stopping -- ruble -- things are made.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of suitable operation of this invention is explained to a detail based on an accompanying drawing. In addition, since the gestalt of the operation described below is the suitable example of this invention, desirable various limitation is attached technically, but especially the range of this invention is not restricted to these gestalten, as long as there is no publication of the purport which limits this invention in the following explanation.

[0015] Drawing 1 is the block diagram showing an example of the semiconductor fabrication machines and equipment with which the production-control approach of this invention is applied, and explains semiconductor fabrication machines and equipment 10 with reference to drawing 1 . The semiconductor device 10 of drawing 1 consists of the wafer processing section 11, the prober Banking Inspection Department 12, the assembly section 13, the Banking Inspection Department 14, and control-section 20 grade. The wafer processing section 11 has a washing station, CVD membrane formation equipment, a sputtering system, ion etching equipment, etc., and forms a transistor, a capacitor, etc. to a wafer. Actuation of the wafer processing section 11 is controlled by the control section 20, and the wafer processing section 11 sends the process quality control data within a process of the processed wafer (it is called "IPQC data" Inline Process Quality Control and the following) to a control section 20.

[0016] Here, IPQC data are data in which information like [in substrate residual film thickness, particle, and a sputtering process] thickness, sheet resistance, and particle was included by line breadth, substrate residual film thickness, and the washing process in line breadth, the doubling gap, and the etching process at dope concentration, sheet resistance, and a photolithography process, such as the thickness, a refractive index, and Phos/Boron, at thickness and a CVD membrane formation process for example, in an oxide-film formation process.

[0017] The wafer processed in the wafer processing section 11 is sent to the prober Banking Inspection Department 12. In order to examine efficiently the electrical characteristics of the electronic circuitry formed on the wafer, the prober Banking Inspection Department 12 contacts a sensing pin to the electrode of each chip automatically, and performs the electric trial of each chip by the circuit tester of the exterior linked to a sensing pin. Here, the prober Banking Inspection Department 12 detects the electrical characteristics EC 1 of the chip in a wafer, and sends to a control section 20. These electrical characteristics EC 1 consist of two or more parameters [EC / EC (1) and / 1] 1 (2) and ... Moreover, the prober Banking Inspection Department 12 judges the quality of a chip based on electrical characteristics EC 1, and sends the quantity of an excellent article to a control section 20.

[0018] The assembly section 13 assembles the chip inspected in the prober Banking Inspection Department 12 for a semi-conductor product. The assembly section 13 has the die JINGU equipment cut from a wafer for each chip, the die bonding equipment which equips a leadframe and a package with a chip, the wirebonding equipment to which the connection electrode and external terminal on a chip are connected electrically, the packaging equipment which carries out packaging of the chip, marking equipment which attaches an alphabetic character and a notation to a package front face. The Banking Inspection Department 14 detects the electrical characteristics EC 2 in the semi-conductor product assembled by the assembly section 13, and sends to a control section 20. These electrical characteristics EC 2 consist of two or more parameters [EC / EC (1) and / 2] 2 (2) and ... Moreover, the Banking Inspection Department 14 judges the quality of a semi-conductor product based on the detected electrical characteristics EC 2, and sends the quantity of an excellent article to a control section 20.

[0019] A control section 20 performs calculation and analysis of the schedule yield while controlling actuation of semiconductor fabrication machines and equipment 10. A control section 20 computes the schedule yield using a predetermined yield prediction type, and, specifically, throws a wafer into the wafer processing section 11 based on the schedule yield. Moreover, if the schedule yield is corrected and there is need based on the quantity of the electrical characteristics EC1 and EC2 to which it is sent [electrical characteristics] from the IPQC data sent from the wafer processing section 11, the prober Banking Inspection Department 12, and the Banking Inspection Department 14, and comes, and an excellent article so that it may mention later, it will control to newly throw in a wafer.
[0020] It is the flow chart Fig. showing an example of the production-control approach of the semi-conductor of this invention, and the production-control approach of a semi-conductor is explained to drawing 2 in detail with reference to drawing 1 and drawing 2 . First, the control section 20 of drawing 1 predicts the yield beforehand (S10), and the wafer of fixed quantity is thrown into the wafer processing section 11 (S11). Then, the wafer processing section 11 performs predetermined processing to a wafer, and a chip is produced (S12). At this time, each activity section of the wafer processing section 11 measures the IPQC data to each wafer, and sends them to a control section 20.
[0021] Next, electric measurement of the chip with which the prober Banking Inspection Department 12 was produced is performed (S13), and the electrical characteristics EC 1 of a chip are detected. The prober Banking Inspection Department 12 judges the quality of a chip in the state of a wafer based on these electrical characteristics EC 1, and classifies an excellent article and a defective. Moreover, the prober Banking Inspection Department 12 also sends the quantity used as an excellent article to a control section 20. The chip judged to be an excellent article in the prober inspection process is sent to the assembly section 13. The assembly section 13 assembles a chip and produces a semi-conductor product (S14). Then, the Banking Inspection Department 14 performs electric measurement to a semi-conductor product, and detects the electrical characteristics EC 2 of a semiconductor chip (S15). The Banking Inspection Department 14 judges the quality of a semiconductor chip based on these electrical characteristics EC 2, and classifies to an excellent article and a defective. Moreover, the Banking Inspection Department 14 sends the quantity of an excellent article to a control section 20. And the semi-conductor product which finished inspection is shipped (S16).
[0022] A control section 20 asks for the schedule yield based on these electrical characteristics [EC / EC and / 2] 1 or electrical characteristics EC1 and EC2 (only hereafter referred to as "EC"). Specifically, the correlation of the electrical characteristics EC and the yield which were detected in the prober Banking Inspection Department 12 and the Banking Inspection Department 14 is analyzed first. If this is shown in a function, the yield function y1 will become like a degree type.
y1=f1 (electrical characteristics EC)
= f1 (electrical characteristics EC (1), electrical characteristics EC (2), ...) ... (1)
And this yield function y1 extracts the parameter EC of the electrical characteristics EC influenced most (m). Then, the yield function y1 turns into the yield function y1 which made electrical characteristics EC (m) the variable.
y1=f2 (electrical characteristics EC (m)) ... (2)
[0023] Next, the correlation of electrical characteristics EC (m) and IPQC data is analyzed. If this is shown in a function, the electrical-characteristics function EC (m) will become like a degree type.
EC(m)=f3 (IPQC)
= f3 (IPQC (1), IPQC (2), ...)
... (3)
And this electrical-characteristics function EC (m) extracts one parameter IPQC (m) influenced most. For example, when a CMOS transistor is produced on a wafer, the threshold electrical potential difference Vth of the CMOS transistor is influenced by the high impurity concentration of a wafer. Therefore, one parameter of the high impurity concentration of a wafer will be extracted among IPQC data. The electrical-characteristics function EC (m) is changed into the electrical-characteristics function EC (m) which made one parameter IPQC (m) the variable here.
EC(m) =f4 (IPQC (m)) ... (4)

[0024] By the formula (2) and the formula (4), the yield function y1 serves as regression which makes a variable one parameter IPQC of IPQC data (m), as shown in a degree type.
Yield function y1=f2 (f4 (IPQC (m)))
= f5 (IPQC (m)) ... (5)
The schedule yield computed using this yield function y1 is compared with the actual yield computed based on the excellent article quantity sent from the Banking Inspection Department 14. And when the yield more nearly actual than the schedule yield is low, a control section 20 is controlled to newly throw a wafer into the wafer processing section 11.
[0025] Since the yield can be predicted from IPQC data by predicting the yield using this yield function y1, when a wafer injection is required, it can supply at an early stage, and the effect of the volume on the semi-conductor product by fluctuation of the yield can be suppressed to the minimum.
[0026] Moreover, a control section 20 can also make the working condition of the activity in the wafer processing section 11 which has affected the parameter IPQC of IPQC data (m) most change based on a formula (5). The fall of the yield can also be prevented to the minimum by changing a working condition so that it may specifically be set to IPQC (m) to which the yield y1 becomes the best in a formula (5).
[0027] The flow chart Fig. showing the gestalt of operation of the 2nd of this invention is shown in drawing 3 , and the production-control approach of a semi-conductor is explained to it with reference to drawing 3 . The point that the production-control approach of the semi-conductor of drawing 3 differs from the production-control approach of the semi-conductor of drawing 2 is a point which made the yield function y2 2 variable function which makes two parameters a variable as shown in a degree type.
y2=f10 (IPQC (m), IPQC (n)) ... (6)
Having considered as 2 variable function depends the yield function y2 on the following reasons. For example, it depends for the drain current Ids of a CMOS transistor on (gate width W / gate length L). Therefore, it turns out that it depends for a drain current on two parameters, gate width W and gate length L, among IPQC data. In this case, the yield can be more correctly predicted by computing the yield using the yield function y2 which made two parameters the variable.
[0028] Here, a formula (6) is explained concretely. First, the correlation of the electrical characteristics EC and the yield which were detected in the prober Banking Inspection Department 12 and the Banking Inspection Department 14 is analyzed. If this is shown in a function, the yield function y2 will become like a degree type.
y2=f6 (electrical characteristics EC)
= f6 (electrical characteristics EC (1), electrical characteristics EC (2), ...)
... (7)
And the parameter EC of electrical characteristics (m) with which this yield function y2 is influenced most is extracted, and the yield function y2 is changed into the yield function y2 which made electrical characteristics EC (m) the variable.
y2=f7 (electrical characteristics EC (m)) ... (8)
[0029] Next, the correlation of the parameter EC of electrical characteristics (m) and IPQC data is analyzed. If this is shown in a function, the electrical-characteristics function EC (m) will become like a degree type.
EC(m)=f8 (IPQC)
= f8 (IPQC (1), IPQC (2), ...)
... (9)
And the electrical-characteristics function EC (m) with which this electrical-characteristics function EC (m) is influenced and which extracted two parameters IPQC (m) and IPQC (n), for example, and made the variable these two parameters IPQC (m) and IPQC (n) becomes like a degree type.
EC(m) =f9 (IPQC (m), IPQC (n)) ... (10)
[0030] By the formula (8) and the formula (10), the yield function y serves as regression which makes a variable two parameters IPQC (m) and IPQC (n).
Yield function y2=f7 (f9 (IPQC (m), IPQC (n)))

= f10 (IPQC (m), IPQC (n)) ... (6)
By predicting the yield using this yield function y2, in each process in the wafer processing section 11, the yield can be predicted from IPQC data, and a production control can be adjusted.
[0031] Moreover, a control section 20 can also make the working condition of the activity in the wafer processing section 11 which has affected most the parameters IPQC (m) and IPQC of IPQC data (n) change based on a formula (6). The fall of the yield can also be prevented to the minimum by setting up a working condition so that it may specifically be made two parameters IPQC (m) and IPQC (n) with which the yield y2 becomes good in a formula (6).
[0032] It is the flow chart Fig. showing the gestalt of implementation of the 3rd of the production-control approach of the semi-conductor of this invention, and the gestalt of the 3rd operation is explained to drawing 4 with reference to drawing 4 . The point that the gestalt of operation of the 3rd of drawing 4 differs from the gestalt of operation of the 1st of drawing 2 is that the yield function y3 is computed in consideration of the case where the 1st parameter IPQC (n) is having effect done by the 2nd parameter IPQC (m).
[0033] Specifically, the electrical characteristics EC by which two or more IPQC data are detected shall be affected. Furthermore, Parameter IPQC (m) shall have affected other parameters IPQC (n). In this case, in the process which processes a wafer, if the activity which affects the 2nd parameter is done, the 1st parameter will also be changed and the schedule yield will also be changed.
IPQC(n) =f11 (IPQC (m)) ... (11)
[0034] Therefore, fluctuation of the 1st parameter IPQC (n) and yield which the 2nd parameter IPQC (m) was changed first and changed by this is analyzed. The yield function y3 at this time becomes like a degree type.
Yield function y3=f12 (f11(IPQC (m)) ... (11))
And in order to control Parameter IPQC (m), the process working condition in the wafer processing section 11 is adjusted. Thereby, when the fall of the yield is predicted from the IPQC data of a certain process in the wafer processing section 11, a working condition is adjusted to degree process and a yield fall can be suppressed to the minimum. Moreover, the quantity which a wafer supplies can also be stopped by predicting the yield including correction of this working condition to the minimum.
[0035] Moreover, fluctuation of the schedule yield is computed from fluctuation of the 2nd parameter IPQC (m), and the working condition of the affecting activity is amended to the 1st parameter (n) in wafer down stream processing so that it may become the 1st parameter IPQC (n) with which this schedule yield is stopped. Thereby, the fall of the yield can be prevented.
[0036] In the production control of a semi-conductor product, by asking for the regression which predicts the yield from the IPQC data of wafer down stream processing, and performing a production adjustment from this prediction yield, the effect by yield fluctuation can be suppressed to the minimum, and, according to the gestalt of the above-mentioned implementation, production control can be performed appropriately. Moreover, in wafer down stream processing, the yield fall of a manufacture lot can be suppressed to the minimum by working by predicting the yield from the IPQC data after predetermined activity termination, and amending the following working condition based on this result.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing an example of the semiconductor fabrication machines and equipment managed by the production-control approach of this invention.
[Drawing 2] The flow chart Fig. showing the gestalt of desirable implementation of the production-control approach of this invention.
[Drawing 3] The flow chart Fig. showing the gestalt of implementation of the 2nd of the production-control approach of this invention.
[Drawing 4] The flow chart Fig. showing the gestalt of implementation of the 3rd of the production-control approach of this invention.
[Drawing 5] The flow chart Fig. showing an example of the conventional production-control approach.
[Description of Notations]
10 [... The assembly section IPQC data / ... The quality control data within a process, EC / ... Electrical characteristics.] ... Semiconductor fabrication machines and equipment, 11 ... The wafer processing section, 12 ... The prober Banking Inspection Department, 13

[Translation done.]

JAPANESE [JP,2000-091178,A]

[Translation done.]